Summary for Intellectual Capital and Knowledge Systems

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1 Meeting 2

1.1 Questions

- Becker
  - What is human capital, what kinds of human capital are discussed
    - training, education, health, morale, etc.
  - What is the basic model (NPV etc., see below)
  - Go through the stylized facts & find the answers given by Becker (see below)
- Ben-Porath
  - Does the model portray a realistic view of the labour market?
    Challenge of discerning between time spent educating and working. Possibility of doing both at same time. Possibility of being paid for work experience not educational, unpaid study time.
  - How does this model, if significant and supported by evidence, help policy makers?
    Difficulty of measuring s_t. Rate of interest r, the rental price of human capital a_0 and price of purchased inputs P_d can be influenced.
  - In which case could δ (the rate of deterioration) be negative? *Discuss scenarios in which human capital could increase over time without schooling.*
- Lazear
  - How does the skill-weights view alleviate some of the problems of classical firm-specific human capital?
    Firm-specific human capital seems difficult to prove, since most knowledge is at least somewhat universal. An approach based on the relative knowledge of general skills is more applicable/realistic.
  - What are possible drawbacks of this approach?
    See page 17: Jobs may not pay for skills beyond a certain point (overqualification) or may exhibit diminishing returns on skills. The approach does not take into account not getting a job at all because of minimum requirements on absolute skill levels.

1.2 (Becker, 1962) "Investment in Human Capital: A Theoretical Analysis"

1.2.1 Stylized Facts

1. Earnings typically increase with age at a decreasing rate. Both the rate of increase and the rate of retardation tend to be positively related the level of skill.

   UU is the untrained person, TT trained person (first paying for, then collecting rent from training). Difference between UU and TT greater the greater the cost of

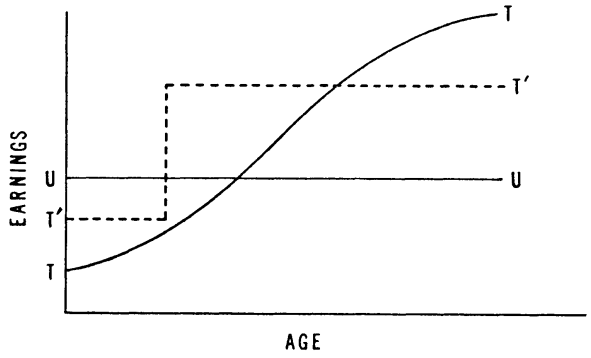

Figure 1: from Becker, p.15

and return from training. Not only does training make the curve steeper, but also more concave. Extreme case TT'.

2. Unemployment rates tend to be negatively related to the level of skill
    - market demand, MP...
3. Firms in underdeveloped countries appear to be more "paternalistic" toward employees than those in developed countries
    - investment in activities outside the job are done when an increase in productivity is the result
    - e.g. health, anti-alcoholism
    - thus, this "paternalistic" behavior results from typical behavior outside the firm!
4. Younger persons change jobs more frequently and receive more on-the-job training than older persons
    - decisions regarding human capital are NPV decisions
    - therefore, they are driven by the time-frame of the decision (on-the-job training)
5. The distribution of earnings is positively skewed, especially among professional and other skilled workers
6. Abler persons receive more education and other kinds of training than others
    - higher MP...
7. The division of labour is limited by the extent of the market
    - a larger market generates *incentives* for more specialization, as higher investments in education are rewarded by higher wages
    - thus, a "larger market" implies more demand for specialized skills...
8. the typical investor in human capital is more impetuous and thus more likely to err than is the typical investor in tangible capital

1.2.2 Basic Model

$$MP = w \tag{1}$$

Workers have different unique productivities (wages) in each period.

$$MP_t = w_t \tag{2}$$

Training lowers current receipts (R) and raises current expenditures (E). However this trend is reversed for future periods. Therefore: NPV consideration.

$$\sum_{t=0}^{n-1} \frac{R_t}{(1+i)^{t+1}} = \sum_{t=0}^{n-1} \frac{E_t}{(1+i)^{t+1}} \tag{3}$$

Now we only have training in the first period; Expenditures in first period are wages + cost of training (k); afterwards only wage. Receipts in all periods is MP.

$$MP_0 + \sum_{t=0}^{n-1} \frac{MP_t}{(1+i)^t} = W_0 + k + \sum_{t=0}^{n-1} \frac{W_t}{(1+i)^t} \tag{4}$$

We define term G

$$G = \sum_{t=1}^{n-1} \frac{MP_t - W_t}{(1+i)^t} \tag{5}$$

Now equation (4) becomes

$$MP_0 + G = W_0 + k \tag{6}$$

Now we need to include the fact that training takes away time from production. (MP_0' what could have been produced, $MP_=$ what was actually produced, C is the sum of opportunity cost and the outlays on training) Equation (6) becomes

$$MP_0' + G = W_0 + C \tag{7}$$

We see that G is the excess of future receipts over future outlays (a notion of return on training). Optimality condition: $G = C$ (return equals cost)

1.2.3 General Training

General Training: This kind of training generally increases the MP of the worker. Since the worker can switch jobs, he will have to bear the costs of this kind of training.

Hence, MP and W are raised by the same amount! $MP_t = W_t \forall t$

$$G = \sum_{t=1}^{n-1} \frac{MP_t - W_t}{(1+i)^t} = 0 \tag{8}$$

Thus, eq. (7) becomes

$$MP_0' = W_0 + C \tag{9}$$

$$\rightarrow W_0 = MP_0' - C \tag{10}$$

1.2.4 Specific Training

Specific Training: This kind of training only increases the MP of the worker for the specific firm. Consequently, in this extreme case firms are willing to pay for the training, since the investment is offset by increases in profit due to higher MP of the workers. On the other hand, workers will not be willing to invest, since they have "no gain" from this kind of investment. The gain is fully absorbed by the firm!

1.3 (Ben-Porath, 1967) "The Production of Human Capital and the Life Cycle of Earnings"

1.3.1 Assumptions

1. Individual utility is not a function of activities involving time as an input.
2. There is a fixed amount of time to be allocated every period to activities that produce earnings and additions to the stock of human capital.
3. The stock of human capital, K, of which every indivudal has some initial endowment, is homogeneous and subject to an exogenouslygiven rate of deterioration, δ.
4. The stock of human capital is not an argument in the individual's utility function.
5. Unlimited borrowing and lending take place at a constant rate of interest, r.

1.3.2 Two stages of decision-making

a) The individual allocates the given periods of time between earning and producing human capital and finds the corresponding outlays on investment that maximize the discounted value of any time t of disposable earnings from t to T, where T is assumed with certainty to be the end of life.

b) Given the optimal time path of disposable earnings, the individual decides on the timing of the consumption.

1.3.3 The Model

a_0 wage, or "rental of human capital"

K a unit of human capital

Y_T earning capacity at time t

$$Y_t = \alpha_0 K_t \tag{1}$$

E_t disposable earnings in period t

I_T cost of investment, equal to $(Y_t - E_t)$

$$Q_t = \beta_0 (s_t K_t)^{\beta_1} D_t^{\beta_2}, \quad \text{where } \beta_1, \beta_2 > 0 \text{ and } \beta_1 + \beta_2 < 1 \tag{2}$$

Q flow of human capital produced

D quantity of purchased inputs

P_d price of purchased inputs

s_t fraction of available stock of human capital allocated to the production of human capital

The fraction s_t is constrained by the condition

$$0_t \leq 1 \tag{3}$$

The rate of change of the capital stock:

$$\dot{K}_t = Q_t - \delta K_t \tag{4}$$

δ rate by which the stock of human capital deteriorates

1.3.4 Findings

- People make most of their investments in themselves when they are young, and to a large extend by foregoing current earnings.
- The larger the stock of human capital, the larger the earnings per unit of time that the individual could get in the market and therefore the higher the foregone earnings from diverting a unit of time away from the market.
- If $\gamma_1 = \gamma_2$ (Cobb-Douglas: Equation (17), p. 360) the more highly educated person is also better equipped for learning, so that his higher opportunity cost is matched by the greater amount of skills that he can acquire per hour.
- If $\gamma_2 > \gamma_1$ capital accumulation reduces the cost of producing human capital, and it is possible even in phase (ii) to have a stretch of time over which investment rises.
- Three phases will exist:
  - Available stock of human capital K_t is not large enough to satisfy demand.
  - Available stock is enough to supply the services demanded, so that $0 < s < 1$ and the services of human capital are truly a variable factor.
  - Stock of capital is too big so that the optimal policy requires more disinvestment than is feasible through deterioration, that is to produce negative quantities of human capital.

- *Normal case*: Capital stock does rise over a period, eventually as gross additions become very small and the stock becomes large this must be reversed, and toward end of life, T, the stock will decline, if there is any deterioration.
- $\dot{I}$ is always negative. Thus the curve of observed earnings exaggerates the rate of increase of earning capacity when the latter increases and understates its decline when it declines.
- If depreciation is zero, there is always, except at point T, an increase in the three types of earnings (E_t - disposable earnings, Y_t - earning capacity, $\hat{E}$ - observed earnings), and at each point in time their rank by rate of change will be the reverse of their rank by level.
- If there is no deterioration ($\delta = 0$) the ever rising curve of observed earnings is always concave from below.
- Possibility that optimal decision requires initial assignment of $s = 1$, or 100% of the labour force educating themselves.

1.4 (Lazear, 2003) "Firm-Specific Human Capital: A Skill-Weights Approach"

1.4.1 Fact sheet

1. The "skill-weights" view allows skills to be general instead of firm-specific. Instead the relative importance of skills makes them more or less attractive to employers.
2. $y_i = \lambda_i A + (1 - \lambda_i)B$ is the potential earning for a worker with skill set (A, B) at firm i.
3. λ_i reflects that firm i may weigh the two skills differently.
4. p is the probability that the worker is going to stay with the current company in the next period.
5. The difference between the earnings growth associated with a given amount of experience for those who stay and those who go leads on the *tenure coefficient*. The amount of wage growth the leavers get loads on the experience coefficient.
6. The worker must chose his investment strategy not knowing whether he will leave the firm or not. p is usually large enough so that he caters to the needs of the first job. When he looses his job he will also loose some income since his skill set will most likely be poorly matched to the new job.
7. The lower p, the less he looses through being let off.
8. The tenure coefficient should be negatively related to the amount of turnover in the occupation.
9. Those who leave a firm with unusual weighting patterns suffer larger wage loss for a given p.

10. *Marketthickness* is modeled as allowing more search: Two draws occur, for the second of which the worker can decide whether to switch jobs or not.

11. In thicker markets a worker looses less on a move despite a more idiosyncratic investment strategy.

12. Investment increases over time because except for a perfect match between the preferences of the first and second company another round of investment is appropriate.

13. Shown with data: It is possible to generate tenure coefficients that are nearly the same size as the experience coefficients (90%).

14. The higher p, the large the tenure coefficient.

15. When λ takes extreme values it tends to be far away from $\bar{\lambda}$, which is why the uniform distribution yields lower tenure coefficients than the bimodal.

2 Meeting 4

2.1 (Destré et al., 2006) "Learning form experience or learning from others?"

2.1.1 Introduction

- Mincerian earnings function: Linear in education, quadratic in labor market experience.
- extended version: includes a quadratic funtion of tenure in the incumbent firm

Here, the authors have a dataset based in France, of 150,000 wage earners and 16,000 establishments. They furthermore distinguish informal training by means of learning from own experience and learning from others.

2.1.2 Informal learning on-the-job from self and others: theory

- workers acquire job-specific training, either formally or informally. Both forms are costly, but the difference is that purely informal learning does not take time away from others.
- informal training often depends on the work contract. workers are "forced" to acquire the knowledge of the firm. Thus, workers bear the cost of training, but also reap the rewards.

Formally, for worker i in firm and job j and time period t: Job-specific human capital h_{ijt}. H_{ijt} is the human capital level of the "teacher" for informal learning. Factor g is the depreciation rate of human capital (normally positive). n is the rate of knowledge diffusion in the firm.

$$h_{ijt} - h_{ij,t-1} = g h_{ij,t-1} + \frac{n}{1+n}(H_{ij,t-1} - h_{ij,t-1}), \forall t \geq 1 \quad (1)$$

Furthermore, it is shown how job-specific human capital grows with "tenure" (time on the job).

$$h_{ijt} = (1+g)^t h_{ij0}(1+(k^t)\lambda_{ij}), \text{ with } \lambda_{ij} = \frac{H_{ij0}}{h_{ij0}} - 1 \forall \lambda ij \geq 0 \quad (3)$$

λ_{ij} denotes the job-specific learning from others' potential, it is independent of tenure. Now, the equation is converted in natural logarithms (for econometric estimation)

$$\log h_{iht} = \log h_{ij0} + gt + \log(1+\lambda_{ij}(1-k^t)) \quad (4)$$

λ can probably be approximated:

$$\log h_{iht} = \log h_{ij0} + gt + \lambda_{ij}(1-k^t) \text{ with } \lambda_{ij} = \log \frac{H_{ij0}}{h_{ij0}} \quad (5)$$

Now, the logarithm of gross earnings is the sum of a linear-in-tenure experience effect and an exponential effect of learning from others that converges fast towards the firm's job-specific learning potential.

2.1.3 The returns to tenure

The marginal returns to tenure (R) are defined as:

$$R_{ijt} = \frac{h_{ijt} - h_{ij,t-1}}{h_{ij,t-1}} \forall t \geq 1$$

"after a few manipulations"

$$R_{ijt} = g + \frac{n}{n+1}\left(\frac{\lambda_{ij}k^{t-1}}{1+\lambda_{ij}(1-k^{t-1})}\right) \quad (6)$$

- returns to tenure is from dependent
- also depends on teacher/worker knowledge ratio
- marginal returns to tenure are shown to be a concave increasing function of the job-specific learning potential
- there is also a convex decreasing relation of the marginal return to tenure with tenure
- increasing the efficiency of learning from others on-the-job will benefit low-tenured workers who will learn faster, but it will reduce what remains to be learned from others in the future

$$\frac{\delta R_{ijt}}{\delta g} \geq 1, \text{ for } t \geq 2 \text{ and } \lambda_{ij} \geq 0 \ (= 1 \text{ if } \lambda_{ij} = 0)$$

Increasing the efficiency of experience initially increases the self-learning effect but this will provoke a multiplier effect in subsequent periods by raising the firm's knowledge.

2.1.4 Data end econometric specification

Large French cross section with matched employer-employee data, 1992 INSEE survey on labor cost and wage structure. Carried out across all EU countries. Regression analysis... additional variables defined in table 1 (p. 926).

2.1.5 Informal learning on-the-job from self and others: results

Summary of the results is given in table 2 (p. 929). Core yelling points:

- on average, it takes 1.93 years for a worker to embody 50% of what she can learn from others in her establishment, and 9.37 years to embody 95% of this in total
- in contrast to the mincerian model, the return on education is slightly lower, this is because one can "learn less" in the firm (regarding return on tenure!)
- less educated workers typically make up for lower education by more work-based learning

2.1.6 firm's knowledge and the returns to tenure

In terms of core yelling points: if there is more knowledge in the firm, the worker will have (depending on the functional form that is specified in the model) a generally higher return on tenure, since he will be able to learn more!

2.1.7 job heterogeneity

The teacher/woker knowledge ratio is quite different per firm. They then divide jobs in two categories, imitation jobs and experience jobs. Jobs that have a low potential to learn from others are called experience jobs. When you can learn from others: Imitation job. Majority of jobs are imitation jobs, only 15.8% of jobs are classified as experience jobs. Return on tenure and t/w ratio differ for these jobs! See table 6 (p. 933).

2.1.8 dualism at the establishment's level

(Establishment: Employer) ... same conclusions can be drawn ...

2.1.9 learning from jobs or learning from firms?

See figure 2 (p. 935), the rate of return to tenure is strongly decreasing for imitation jobs, whereas it stays constant for experience jobs! Furthermore, the average marginal rate of return to self-learning is considerably higher for experience jobs than for imitation jobs. Workers with experience jobs don't learn from others but by themselves. The marginal returns to education are lower in imitation jobs, more educated workers have less to learn from others.

2.1.10 conclusions

Taken directly from article:
We have suggested a simple model of informal learning on-the-job which combines learning from (own) experience and learning from others. This yields a closed-form solution that revises the Mincer–Jovanovic's (1981) treatment of tenure in the human capital earnings function by relating earnings to the individual's job-specific learning potential. We estimated the structural parameters of this non-linear model on a large French cross-section with matched employer–employee data. We find that workers on average can learn from others 10% of their own human capital on entering the firm, and catch half of their learning potential in just 2 years. Since individuals learn fast from their co-workers, the estimated returns to tenure loom larger than predicted by a quadratic, or even a quartic-in-tenure, Mincerian function in the first years and decline more sharply (until about 30 years). Learning by watching accounts for three quarters of the marginal rate of return in the first year of tenure, but this share falls rapidly, with an average of 12%. While education and self-learning on-the-job are complementary, education and learning from others on-the-job are substitutes. The more education, the less can be learned from others. This forces the private marginal return curve to decline with education, an effect which was not captured by current theory. Seen from a different perspective, the more educated workers share the social returns of their own education with their less qualified co-workers. The potential for learning from others on the job varies across jobs and establishments, and this provides a new distinction between imitation jobs and experience jobs. Workers in imitation jobs, who learn most from others, tend to have considerably longer tenure than workers in experience jobs. The latter are more mobile and have accumulated more market experience. Although workers in experience jobs can learn little from others, we find that they learn a lot by themselves. Consequently, we do not find a close correspondence between the imitation jobs/experience jobs "dualism" and the primary/secondary jobs and firms' dualism implied by the dual labor market theory. Even though imitation jobs imply far less turnover than experience jobs, imitation jobs do not appear to be "better" in terms of education levels and wages. We show, however, that predictions of the dual labor market theory which cannot be observed at the job's level under our classification of jobs emerge from the aggregation of jobs at the establishment level. Furthermore, we find no evidence of rationing of primary-type jobs and establishments. Competition prevails between jobs and firms but jobs differ by their learning technology. Firms that make an intensive use of learning from others adhere rather naturally to more collective forms of workers' governance such as reliance to trade unions in comparison with those that make an intensive use of self-learning.

2.2 (Ertaut, 2000) "Non-formal learning and tacit knowledge in professional work"

– Moritz

3 Meeting 5

3.1 (Leuven & Oosterbeek, 2008) "An alternative approach to estimate the wage returns to private-sector training"

This paper introduces the two typical kinds of upward biases found in the studies on return on education / private-sector training. These biases are the selection bias and the bias of unobservables. ($\rightarrow$ ability bias)

- There is a selection bias in many regressions of wages on training, since more able workers (= higher productivity and higher wages) self-select into training.
- It is also hard to find variables that only affect training, but not wages (this is called bias of unobservables)
- Thus, the effect of private-sector training is typically overstated
- In this paper, the authors compare the effect of private-sector training on wages of workers that took training to workers who **wanted** to take training, but could not do so due to some random reason
- Here, the selection bias should be much smaller.
-

3.2 (Leigh, 2008) "Estimating returns to education using different natural experimentation techniques"

The authors try to find the return on education in Australia using three natural experiments. Using a regular OLS regression, the return on one additional year of schooling is estimated to be 12%. However, taking the natural experiments into account:

1. **Month of birth**
   Here they look at individuals that are born just one month to late to begin schooling with their cohort. Because they assume that the other characteristics are comparable, they can identify the return (in terms of wages) of one more year of schooling. The estimated return on one additional year of schooling is found to be 8%
2. **Changes in compulsory schooling laws**
   Here they look at years in which the number of years of schooling was changed in the legislature. Therefore the authors again have a basis of comparison, because again most other characteristics of the observations are likely to be the same.
   The estimated return on one additional year of schooling is found to be 12%
3. **Twins**
   Here they look at wage differences between twins that have obtained different levels of education. Because the twins are genetically (nearly) identical, they share most of the other characteristics apart from schooling.

3.3 (Bedi & Gaston, 1999) "Using variation in schooling availability to estimate educational returns for Honduras"

The authors estimate the return on schooling in Honduras (for males) by looking at the actual availability of schools at the time when the individuals were eligible to start schooling. It is pointed out that most studies so far only concentrate on developed countries. abs

3.4 General Remarks

- self-selection of clever people: overestimation of the effect of education → bias
- unobserved factors; ability versus cost of education
- policy implications: Honduras, worthwhile to invest in education? / Which level of education?

4 Meeting 7

–Moritz

5 Meeting 8

–Norman

6 Meeting 10

–Moritz

A Glossary

A.1 Instrumental Variables (IV)

In statistics, econometrics, epidemiology and related disciplines, the method of instrumental variables (IV) is used to estimate causal relationships when controlled experiments are not feasible. Statistically, IV methods allow consistent estimation when the explanatory variables (covariates) are correlated with the error terms. Such correlation may occur when the dependent variable causes at least one of the covariates ("reverse" causation), when there are relevant explanatory variables which are omitted from the model, or when the covariates are subject to measurement error. In this situation, ordinary linear regression generally produces biased and inconsistent estimates. However, if an instrument is available, consistent estimates may still be obtained. An instrument is a variable that does not itself belong in the explanatory equation and is correlated with the endogenous explanatory variables, conditional on the other covariates.

In linear models, there are two main requirements for using an IV:

- The instrument must be correlated with the endogenous explanatory variables, conditional on the other covariates.
- The instrument cannot be correlated with the error term in the explanatory equation, that is, the instrument cannot suffer from the same problem as the original predicting variable.

Source: Wikipedia